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**Exploring New Directions
for the National Household
Travel Survey**

Phase Two Report of Activities

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TRANSPORTATION RESEARCH CIRCULAR E-C217

Exploring New Directions for the National Household Travel Survey

Phase Two Report of Activities

Prepared by

Task Force on Understanding New Directions for the National Household Travel Survey

December 2016

Transportation Research Board
500 Fifth Street, NW
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The **Transportation Research Board** is one of seven programs of the National Academies of Sciences, Engineering, and Medicine. The mission of the Transportation Research Board is to provide leadership in transportation innovation and progress through research and information exchange, conducted within a setting that is objective, interdisciplinary, and multimodal.

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Preface

The National Household Travel Survey (NHTS), administered by the Federal Highway Administration (FHWA), provided data on personal travel in the United States in 2001 and 2009. Its predecessor, the National Personal Transportation Survey, was collected five times between 1969 and 1995. The 2016 NHTS was launched in spring 2016 and the 1-year data collection is ongoing.

The Transportation Research Board (TRB) Task Force on Understanding New Directions for the NHTS was formed in fall 2011. The mission of the task force is to serve as a bridge between the NHTS data user community—including researchers and practitioners—and the FHWA with respect to the design of future NHTS efforts, including the current 2016 data collection as well as anticipated future surveys.

The purpose of this e-circular is to summarize the status, approach, and expected content of the new NHTS data for the user community. This introduction to the scale and type of changes is intended to allow agencies, programs, and research groups to prepare for use of the data that is expected to be released in late 2017. The content of this e-circular is drawn from the FHWA NHTS team, the FHWA's consultant Westat, and discussions of the TRB task force. The e-circular should not be considered comprehensive coverage of methodology or full technical documentation. The final survey design parameters, response, data tabulation, and methodology will be published elsewhere. This document does not represent the views of all members of the task force, FHWA, or TRB.

The objective of this e-circular is to start a broad conversation among data users about the updates to the NHTS and for the user community to start preparing for the changes in the data. While some changes were necessitated by the societal landscape within which survey research must operate, such as low response rates and decreasing numbers of landline telephones, other changes in design, approach, and content were made in response to the user community. Many of the change requests were gathered by this task force and summarized in *Transportation Research Circular E-C178: Exploring New Directions for the National Household Travel Survey*. As detailed in Circular E-C178, NHTS was most often used to study, describe, or analyze the following:

- Travel, including measures of mobility such as trip rates, miles traveled, vehicle availability, access to public transportation, walk and bicycle trips, type of area, socioeconomic status of the traveler, the amount and nature of travel by each mode, and temporal patterns of daily travel.
- Energy consumption, environmental concerns, and household vehicles, including air quality modeling, energy consumption of the household vehicle fleet, relationship between gas prices and travel, and impact of hybrid and electric vehicles.
- Travel of specific demographic groups and the travel behavior of millennials, mobility issues of the elderly, and specific patterns of immigrant and low-income groups.
- Modeling and planning applications, including use of the NHTS in calibrating and validating state and regional travel demand models (both four-step and activity-based models), the intersection of land use and travel behavior, and linking NHTS data with American Community Survey data.

- Safety, providing travel data by age, gender, and other variables needed to give broader context to crash and fatality data, analysis of children's exposure to crashes on the trip to and from school, and time of day of travel for comparison with incidence of crashes.

Circular E-C178 documented a robust collection of topics and design suggestions offered by the greater NHTS user community. All of the suggested topics and design elements were considered seriously but the constraints only allowed for the adoption of some. The most significant of these is the time it takes to complete the survey given the detailed data that is collected. With dropping response rates and an American population that is saturated with requests for their attention, great care needs to be taken to constrain the amount of detail collected. The requested new data all added to the core NHTS data that has been collected over the past 47 years of the survey.

Funding constraints also played a role in decisions of expanding survey content, but the time burden on individual respondents far outweighed all other factors.

A summary of the data requested by the NHTS user community, as documented in Circular E-C178, follows:

- Mode choice: the degree transportation decisions are dictated by household location and access to and from transportation hubs like airports.
- Travel substitution: more on teleworking, online shopping, and services.
- Use of emerging modes such as Uber and Lyft.
- Extended time frame for collecting longer trip data.
- Traffic conditions, including more on congestion, weather, and road conditions.
- Trade-off of mobility and environmental concerns.
- The health benefits, environmental benefits, and safety issues of walking and biking.
- Use of advanced vehicle technology for navigation, information, and crash avoidance.
- Parking availability and parking costs.
- Use of toll roads and variable pricing arrangements (e.g., E-ZPass).
- Availability of electric vehicle charging stations.
- More detail on each household vehicle, such as vehicle identification number, fuel purchase logs, transmission and engine options, advanced vehicle technology for navigation, and crash avoidance.
- For each travel day trip, data collection on all vehicle occupants (not just household members), including seating arrangements, age, gender, worker status, use of seat belts, driving experience, type of driver's license, and availability and cost of other possible modes.
- Cost data on travel.

The following changes to survey method and procedures were suggested:

- Use of GPS for tracking travel.
- Only using households where 100% of all household members reported their travel.
- Use a core survey with separate modules for specific issues or subgroups.
- Don't include weekend travel, since it is not used in travel demand modeling.
- Collect more than one day of travel for each household.
- Oversample rural households.

- Focus on specific groups with safety issues (e.g., teens, seniors, and high-risk drivers).
- Improved geocoding of trip ends.
- Oversample nonmotorized groups and transit use.
- Using smaller local samples, obtain data to show how local transport system changes affect travel behavior.

From the data and methods requested in Circular E-C178, some were adopted, others were incorporated indirectly due to the changes in the way the data is being collected, and others were not possible as they were either beyond the scope of the NHTS or would require a follow-up survey which is not feasible for reasons of funding and respondent burden. There were some changes made to better serve the needs of the modeling community, but these were balanced with a need to maintain the survey series in the unique role it has played as a source of travel behavior data.

The specific changes made in the 2016 NHTS include the following:

- Use of emerging modes such as Uber and Lyft;
- A health-benefit perspective on walking and biking;
- Change in the definition of a complete household to be one where 100% of all household members reported their travel; and
- Change in sampling frequency to emphasize weekday versus weekend travel.

While resources and practical limitations will always be a reality, users may benefit from considering further growth of the NHTS program and communicating their ongoing needs, uses, and ideas to the TRB task force as it continues its work.

The task force acknowledges support from the FHWA Office of Highway Policy Information, as it continues to enable the task force's work.

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National Household Travel Survey Data Collection Process

The National Household Travel Survey (NHTS) is the source of the nation's personal travel information and is used by the administration, Congress, national and local policy makers, and transportation planners to study the extent and type of daily travel in the United States. This inventory of travel behavior reflects travel mode (private vehicle, public transportation, pedestrian, and cycling) and trip purpose (travel to work, school, recreation, and personal or family trips) by U.S. household residents. Survey results are used by federal and state agencies to monitor the performance and adequacy of current facilities and infrastructure, and to plan for future needs. Data from the NHTS are included in broader, biannual reports to Congress on the performance of the surface transportation system.

The collection and analysis of national transportation data has been of critical importance for nearly half a century. Previous surveys were conducted in 1969, 1977, 1983, 1990, 1995, 2001, and 2009. The current survey (2016 NHTS) is the eighth in this series, and allows researchers, planners, and officials at the state and federal levels to monitor travel trends. The NHTS is the only national source of data on how the travel behavior of the American public is changing as demographic, economics and cultural changes are taking place in our country.

Title 23, United States Code, Section 502 authorizes the U.S. Department of Transportation (DOT) to carry out advanced research and transportation research to measure the performance of the surface transportation systems in the United States, including efficiency, energy use, air quality, congestion, and safety of the highway and intermodal transportation systems. The U.S. DOT is charged with the overall responsibility to obtain current information on national patterns of travel, which establishes a data base to better understand travel behavior, evaluate the use of transportation facilities, and gauge the impact of the U.S. DOT's policies and programs.

Data from the NHTS are widely used to support research needs within the U.S. DOT, and state and local agencies, in addition to responding to queries from Congress, the research community and the media on important issues. Current and recent topics of interest include the following:

- Travel to work patterns by vehicle mode for infrastructure improvements and congestion reduction;
- Access to public transit, paratransit, and rail services by various demographic groups;
- Incidence of vehicle ownership at various income levels;
- Measures of travel by mode to establish exposure rates for highway safety analyses;
- Bike and walk travel for safety, health measures, and environmental concerns; and
- Support for federal, state, and local planning activities and policy evaluation.

Within the U.S. DOT, the Federal Highway Administration (FHWA) holds responsibility for technical and funding coordination. The National Highway Traffic Safety Administration, Federal Transit Administration, and the Bureau of Transportation Statistics (BTS) are also primary data users, and historically have participated in project planning and financial support. Recent changes in travel behavior combined with the transportation community's emphasis on performance measurement underscore the importance of reliable data for evidence-based decisions. The diversity of information needed to support the wide range of transportation

decisions in the current environment is challenging. The NHTS provides critical data on individual travel behavior trends linked to economic, demographic, and geographic factors that influence travel decisions and help predict travel demand.

The NHTS data are unique and not available from any other source since they are collected directly from a stratified random sample of U.S. households. They describe travel behavior that informs research and policy initiatives that relate to safety, congestion, finance, mobility, accessibility, and forecasted demand.

This e-circular is the second of a series of e-circulars put out by the Transportation Research Board Task Force on Future Directions for the NHTS. The role of the task force is to serve as a liaison between the NHTS user community and FHWA and provide feedback from the user community to FHWA as they work on the NHTS program.

This e-circular is structured as follows. This section focuses on the NHTS data collection process and discusses the redesign of the NHTS, the recruitment of add-on participants, planning for the survey, the Office of Management and Budget (OMB) process and the outcome of the expert panel workshops. The second section discusses the sample design, and the third section discusses data collection methods. The fourth section is focused on the questionnaire design and the fifth section discusses the lessons learned from the pretest. This e-circular concludes with a discussion on some ideas for future research.

THE DECISION-MAKING PROCESS

Redesign and Survey Design Plan

Like many major national surveys, the NHTS has had to adapt to changes in the way we live and the way we communicate. The NHTS has been conducted over a 47-year span using the telephone as the means of contact with survey respondents between 1990 and 2009. During that time a random digit dialing (RDD) sample frame of telephone numbers was used to select a sample of U.S. households to participate in the survey. With the increase of households “cutting the cord” to their landlines and relying only on cell phones, the RDD landline sample frame is no longer a viable representative list of the American public.

In preparation for this change, the 2009 NHTS included a small, experimental sample of cell phone–only households. This sample constituted a process test to determine whether the survey could be completed by a cell phone user. This test was successful in determining that a telephone NHTS survey could be conducted with households that did not have a landline.

Simultaneously with the decrease in telephone surveys, the U.S. Postal Service started allowing access to their computerized delivery sequence file which provides a database of all residential addresses in the United States. Many other national surveys have been using this address-based sample (ABS) frame to convert telephone surveys to mail surveys. The NHTS could have continued to be conducted by phone, assuming a melding of a landline sample frame with a cell phone sample frame. At the time, redesign decisions were made it was estimated that landline phone numbers would cover only about 60% of all U.S. households. Thus a cell phone sample frame would be needed as an essential element of the survey.

The two largest concerns about continuing as a phone survey were that the public was less willing to participate in long, detailed phone surveys and, with increasing cell phone usage, the area code was no longer a valid representation of where the potential respondent lived. Thus

continuing to use telephone numbers as a sample frame would not provide the geographic specificity needed to distribute the sample for purposes of both the national sample funded by FHWA and the add-on samples funded by states and metropolitan planning organizations (MPOs). These concerns were the major factors in deciding to use an ABS as the sample frame for the 2016 NHTS.

Once the decision was made to use an ABS sample the primary issue was what contact and response modes to use for the two stages of the NHTS: the initial recruit stage and the much longer and complex retrieval stage. Use of an ABS sample dictated that mail would be the initial contact mode of the survey. However, the complex and detailed information collected in the retrieval stage comprises the heart of the NHTS content and is most difficult to collect fully and accurately. Three collection modes were considered for the retrieval stage: mail, telephone, or a web-based questionnaire. The collection mode choice was made using what was known about other household travel surveys as well as other national surveys that had converted to ABS. Factors of concern in the retrieval mode selection included the impact of this decision on the following:

- The need to have all household respondents participate in the survey and report for the same day of travel;
- The need to educate the respondents on the definition of a “trip”—the basic unit of reporting the core travel data;
- The need to reduce burden versus the need for greater detail to satisfy new modeling trends among add-on agencies;
- The geographic specificity required to report the start and end point of each trip;
- Simplifying the job of the adult household member who reported trips for himself or herself as well as the children in the household;
- How to transition from using mail as the mode for the initial contact and recruitment of the household to another mode for collecting the detailed data in the retrieval portion of the survey;
- How to handle adult proxy reporting, when one adult reported for another adult household member; and
- For items requiring coding, such as trip purpose, travel mean, and occupation category, whether they could be completed effectively without an interviewer at the other end of a phone line.

An additional factor was that the definition of a completed household was changed from at least 50% of adult household members completing the retrieval survey to all eligible household members, which would accommodate the evolving requirements of most state and regional transportation planning and modeling agencies.

To address these and other concerns, the final design used an initial mailing with a simplified mail-back recruit questionnaire and an online site for collecting the much more detailed retrieval portion of the data. For those not wanting to do the retrieval online, a phone interview option was available.

The survey design called for mailing a short recruitment questionnaire designed to collect some opinions about daily travel, an enumeration of all household members, and additional contact information in the form of an e-mail address and a telephone number. The contact information is essential to prompt all household members to complete the detailed retrieval

portion and to respond to any questions on the survey process. While it would have been consistent to use a mail-back recruit followed by a mail-back retrieval, it was determined that the content of the NHTS questionnaire was too lengthy, too repetitive, and too complex for a mail-back questionnaire. Given the nature of what is collected, household travel surveys tend to be both difficult and boring at the same time. Therefore, a web-based data retrieval tool was thought to be a good option for the NHTS.

The heart of a household travel survey is collecting all trips made by each household member over a prescribed 24-h period. Because of the visual and geographic aspect of this content, a web-based tool was developed to allow for mapping the origin and destination of each trip along with collecting related trip attributes, such as trip purpose, mode of transportation, and other people on the same trip. Other household travel surveys had successfully used a similar approach and the American public is increasingly familiar with similar mapping technology.

However, given that not all potential respondents were going to be comfortable with web-based data collection, nor do all have ready access to a computer or Internet, the survey design plan also called for a phone interview retrieval. Consideration was given to a cell phone version of the software, but at the time survey planning decisions were being made, cell phone technology did not allow for displaying the required mapping software along with trip characteristics questions.

National Household Travel Survey Content

The content of the NHTS was composed of three categories: core content that remained the same over time, new topics designed to address timely issues, and six questions that each add-on jurisdiction included for respondents in their respective areas. The add-on component and these additional questions are discussed in below.

Much of the core content of the NHTS has been collected since the first survey in the series was conducted in 1969. The core is basically characteristics of each household member, household income, worker and driver status of each household member age 16 and older, some limited data on each household vehicle, and the inventory of all trips taken in a specified 24-h period. The core data comprised the bulk of the survey and most of the respondent burden.

With each new survey in the series some timely transportation issues were included as well as some respondent opinions on the transportation system. Both of these topic areas were designed to both encourage participation and provide data on current topics. For the 2016 survey, the new topics included public health, active transportation, accessibility, and the impacts of technology and the Internet on transportation. FHWA coordinated with the Centers for Disease Control and Prevention to study walk and bike behavior, encourage the use of these travel means, and provide data to measure the trends in these nonmotorized travel means.

The new questions added to the survey included the following:

- At the household level:
 - Location choice (four add-on questions),
 - Home Internet access,
 - Home deliveries,
 - Investment priorities (two add-on questions),
 - Participate in follow-up studies (six add-on questions),
 - Long-distance travel (five add-on questions),

- Airport choice (two add-on questions),
- Shopping trips, and
- Children's travel to school;
- At the person level:
 - Student status,
 - Workers,
 - Use of transit (two add-on questions),
 - Work schedule,
 - Seasonal variations,
 - Long-distance travel,
 - Use of alternative modes and park-and-ride,
 - Impact of fuel prices,
 - Active transportation, and
 - Factors and attitudes; and
- At the trip level:
 - Toll and parking cost (where applicable),
 - Mode-specific details, and
 - Why transit for this trip?

Timeline for Implementation

The timeline for fielding the NHTS survey was composed of a number of key, sometimes overlapping, events.

- Obtain input on the survey methods and content from the large and varied user community;
- Obtain sufficient funding to conduct the FHWA-sponsored portion of the survey and get a contract initiated;
- Develop and publish an RFP (request for proposal) to get proposals and bids from survey research firms;
- Review proposal and execute a contract with the selected survey firm;
- Continue involvement with the user community and conduct all the planning and design work leading to the submission of an OMB clearance package; the OMB package reflects all methodology and sampling decisions, questionnaires for both the recruit and retrieval portions of survey, a detailed sampling plan, and survey operations; and
- Upon OMB approval, plan and conduct a pretest to determine the viability of the survey; namely, what works and what needs adjustment prior to fielding the full survey.

The original plan was to get the full survey into the field by the autumn of 2015, but this milestone was delayed until spring of 2016. As in many of the previous iterations of the survey, the two bottleneck points were creating and submitting an RFP and obtaining OMB clearance, each of these activities resulting in a delay of 3 to 4 months.

The survey was fielded at the end of March 2016 and it is expected to take about 14 months for data collection, so field operations are expected to conclude around June–July 2017. Total processing time for the post-data collection stage is expected to take 6 months, with public data possibly being made available around early 2018. Post-data collection processing includes

final edits, quality control (QC) checks, weighting the data, and documenting the data and the survey process. This timing is typical for a large, complex survey such as the NHTS, particularly given the multiple survey sponsors of FHWA and the 13 add-on states and MPOs.

ADD-ON COMPONENT

The add-on component allows states and MPOs to purchase additional samples in their geographic area to serve as their household travel survey. The add-ons represent a major component of the NHTS and contribute more than 75% of the samples to the NHTS. Therefore, the add-ons are a critical component to the success of the NHTS and FHWA works closely with the add-ons to obtain a representative sample. The add-ons also get the advantage of not having to coordinate contracting or oversight and get economies of scale which provides high-quality data at low risk and is consistent locally and nationally.

For the 2016 NHTS, the total sample is 129,112 completed households, with 26,000 from the national sample and the remaining 103,112 from the 13 add-on partners (Table 1).

The add-on component has been part of every NHTS survey since 1990, and many states and MPOs were aware of the upcoming 2016 NHTS. The formal recruiting for the 2016 add-ons was started in 2013 with a series of webinars that provided information on the plans for the 2016 survey and gave potential add-ons the opportunity to ask questions. A formal Add-On Guide was also created to provide add-ons with information on the attributes in joining the NHTS. In December of 2013, the FHWA NHTS team offered two full-day peer exchange sessions at the Little Rock, Arkansas, and Denver, Colorado, FHWA Division offices. Prospective add-on partners were given presentations on the survey and each workshop had a detailed question-and-answer period. These workshops served several states and MPOs.

TABLE 1 Study Areas and Target Sample Sizes

Study Area	Sample Size ^a
National	26,000
Arizona DOT	2,444
California DOT	24,000
Des Moines area MPO	1,200
Georgia DOT	8,000
Indian Nations Council of Governments	1,000
Iowa Northland Regional Council of Governments	1,200
Maryland DOT	1,000
New York State DOT	15,851
North Carolina DOT	8,000
South Carolina DOT	6,500
Wisconsin DOT	11,000
Texas DOT	20,000
North Central Texas Council of Governments	2,917
Total	129,112

^a These are households for which all of the household members ages 5 and older complete the retrieval survey.

FHWA incorporated two new elements of add-on support into the 2016 survey:

- Statistical assistance in defining each add-on's sampling plan; and
- A dedicated add-on coordination team to work with each jurisdiction from the early planning stages through completion of the survey and dataset analysis.

Assistance with the sampling plan for each add-on allowed for much greater coordination with the survey contractor. Each jurisdiction had unique needs and very detailed plans were created for stratification of the add-on sample within each jurisdiction and other criteria needed for the add-on sponsor. Given that the national sample would also have some representation within each add-on area, coordination between the two sample frames was also accomplished.

The add-on coordination team started in September 2014 and serves as the primary point of contact for staff from each add-on, covering the full spectrum of survey issues. Add-ons were also allowed to vary their sampling frequency to put more emphasis on weekday travel days and less on the weekend. This was done to better serve their travel demand modeling needs. The team helped each add-on understand and work through the process of obtaining add-on-specific samples. As the survey was fielded, this team served the function of coordinating and updating each of the 13 add-on jurisdictions with survey status information. Given the fact that the add-on participants vary by NHTS data collection year (some 2009 participants are not part of the 2016 NHTS or vice versa), it is critical while doing trend analysis to understand the sampling issues that might arise from these especially when considering things such as transit availability.

The NHTS may be the only federal survey that has established this unique component directly serving states and metropolitan entities. Many federal surveys collect data valid at the state and metropolitan level, but it is possible that NHTS is the only one that has formed this unique partnership in cosponsoring the conduct of the survey.

For more information on the add-on component, see the NHTS website at <http://nhts.ornl.gov/addOn.shtml>.

SURVEY PLAN

The 2016 NHTS continued to use the two-stage survey approach with an ABS frame, mail out-mail back recruitment stage and web-based travel day retrieval. Multiple reminders at key points and cash incentives at key stages were included in the design.

The survey is designed to begin with mailing the sampled households a short recruitment survey to collect key household enumeration information and some engaging travel-related opinion or experience questions considered to be both highly relevant to the survey and interesting to the respondents. That initial recruitment package included an invitation letter, a \$2 incentive, the short recruitment survey and a business reply envelope (BRE) to be used to return the completed information. In the recruitment survey, respondents were asked to provide a telephone number and e-mail address to be used as reminder or validation forms of communication.

If households failed to respond to the initial recruitment survey then several follow-up mail reminders were sent starting at day 7 of the initial mailing. Three weeks after the initial mailing all nonresponding addresses were sent a second recruitment packet (without incentive). The final mailing provided the household a personal identification number (PIN), which enabled

the household to self-initiate and complete the recruitment survey on the web. Survey methods research has shown that staying with the initial recruit method for as long as possible yields improved response rates. Nonresponding households are not called at the recruitment stage, though telephone-assisted interviewer support is available if requested.

To reach households that only speak Spanish, all mailings included a tag line in Spanish that provided households with the website address and a PIN to access electronic versions in Spanish of both the recruitment and retrieval instruments.

The overall recruitment design was intended to minimize nonresponse by providing multiple sequential recruitment contacts based on design principles laid out by Dillman, Smyth, and Christian.¹

During the sampling stage of the national sample, each sampled address was assigned a day of week. This method of assigning one-seventh of the sample to each day of week has been effectively used in numerous studies to balance the day of week distribution across the study period. Balancing of travel date assignment occurred through the staggered approach to mailing invitations in the sample release process. The actual travel date assignment occurred after the recruitment survey has been returned and processed. The household was assigned a travel date that was at least 10 days in the future and on the day of week assigned to the address in the sampling stage. The 10-day span allowed Westat (the data collection contractor) to prepare personalized travel log packages and mail those packages to arrive at the household prior to the travel day.

The travel log package contained a letter that explained the next steps, identified the assigned travel date,² discussed the incentive for completion, and provided contact information if the household had questions or needed assistance to complete the survey. Also included was a personalized travel log for each household member ages 5 and older and a \$5 cash household incentive.

The retrieval reminder process used e-mail, telephone, or text reminders and began when the travel log package was mailed. The travel log mailing triggered the first reminder and if an e-mail address was provided, an e-mail was sent or a call was given to inform the household of their assigned travel day and to look for materials in the mail. After the travel day, households that provided telephone as their retrieval preference were called by an interviewer on the first day following their assigned travel day. If the household selected web as their preference they received an e-mail reminder the day after the travel date that prompted them to complete the final step online. Those who did not respond were contacted by telephone 2 days after their travel date to complete the retrieval survey by phone.

As in past NHTS, the 7-day retrieval data collection window period was implemented and it allowed exceptions for those households that initiate contact by web or telephone. No attempts to initiate contact with households to complete the survey beyond the seventh day were made. However, the website remained open for 1 month beyond the travel date for those that still wanted to complete the survey. The date of retrieval survey completion is recorded to enable analysis of elapsed time effects on survey responses.

A dedicated hotline number was provided to assist respondents. Help desk staff members were trained to address general and specific survey questions to resolve technical issues and assist in the completion of the survey. The help desk was staffed from 9 a.m. to midnight Monday through Friday, 10 a.m. to 9 p.m. on Saturday, and 2 p.m. to midnight on Sunday, EST. Respondents could leave a message when staff members were unavailable to take their call. All voicemails and e-mails had a 24-h turnaround response period.

In support of FHWA's vehicle miles traveled estimates, a shortest network path distance was calculated and included for each reported trip. Google Maps were used for motorized modes routes that used road network shortest path as well as for nonmotorized modes walk network routes paths. These distances are provided for each route generated by the Google Maps API used for geocoding. These distance estimates were calculated for all reported trips for all add-on households whenever a route was available to a household. In addition, an as-the-crow-flies distance for each reported trip will be provided in the final dataset, values of which will be computed using the great-circle formula.³ This distance will be included for each trip where an origin and destination was reported.

For the 2016 NHTS, the definition of a completed household required 100% of eligible (age 5 and older) household members to complete the survey. Although the household roster was enumerated during the recruitment stage, all household members had to be a resident on the travel date. Because the sample unit was an address versus a telephone number, only those currently living at the sampled address were eligible. New residents to the household were added at the retrieval survey.

The changes in methodology impacted the ability to adhere to proxy rules. When surveys were completed online, there was little that could be done to verify which person completed the survey. In the retrieval instrument, before travel day reporting began, respondents were asked to select their name from the list of all household members age 16 or older. Afterwards, they were instructed to select the name of the person for whom they were reporting travel from a second list. This second list contained all household members age 5 and older. Data from these variables will be used to construct a report on the amount and frequency of proxy reporting. Interviews conducted by telephone included these questions although interviewers were instructed to try to complete each retrieval interview with the subject, but accepted a proxy report.

Incentives

Incentives are provided in incremental steps at three stages of the survey process. Each initial sampled address received a \$2 cash incentive in the first mailing. Following the household's recruitment, the second incentive of \$5 cash was sent with the travel log package. A \$20 check was sent at the completion of the retrieval survey. The disposition of incentives paid was tracked at each of the three stages, including those that were returned as either postal nondeliverable mail and for cases where participants returned incentives. Those respondents that claimed to have never received the promised incentive were sent a replacement check in the amount not received.

Data Confidentiality and Security

Each NHTS team member and Westat staff member who worked on the NHTS signed a statement of confidentiality and Westat staff members were required to complete an annual human subjects' protection training. Respondents were informed that their participation was voluntary and their information would be kept confidential as required by law. A data confidentiality agreement was required of all those who worked on the NHTS and from each add-on data recipient. Strict security procedures were implemented to protect print and electronic material that contained identifying or confidential information. Further protection of respondent data will be carried out through a combination of data security protocols, masking, and statistical technics.

OFFICE OF MANAGEMENT AND BUDGET'S ROLE IN DESIGN AND SCHEDULE

All federally funded surveys of nine or more respondents must be cleared by the OMB's Office of Statistical Programs in accordance with the Paperwork Reduction Act. The primary purpose of this clearance is to insure a federal agency is not burdening the public by collecting information already available from another agency or another source. Additionally, OMB checks on the reasonableness of what is being asked, the suitability of the survey for the needs it purports to fill, and the necessity for any potential sensitive information asked. The OMB clearance process is also designed to insure that survey statistical and methodological norms are being met.

OMB clearance is typically done after survey planning and some survey preparation, but before any pretest or pilot testing. The required clearance package is quite detailed and requires not only the plans for the survey, but also the rationale for decision making in the planning process. A draft questionnaire is part of the OMB package, as well as a detailed description of sampling and statistical methods.

OMB clearance of a DOT survey is really a two-step process. The first set of reviews and revisions took place in the internal DOT process, involving FHWA, BTS, and the Office of the Secretary. For the 2016 NHTS the internal DOT process took from May through July of 2015. Questions raised in the DOT review included the following:

- The possibility of using a mail-back questionnaire for the detailed retrieval portion of the survey;
- Whether standard errors could be calculated for state-level data in the final dataset;
- How the data will be adjusted to normalize for not obtaining equal number of interviews on each day of the week or month of the year; and
- Clarification of the detailed weighting scheme proposed for the national and add-on samples.

As needed, the OMB package was revised to clarify and strengthen those topics. The NHTS package was submitted to OMB in August 2015 and clearance was received in early November 2015. The primary issues raised in this NHTS series by OMB staff were issues that addressed incentive methods and respondent burden of time and the collection of race and ethnicity standards. All other issues were sufficiently addressed in the supporting statements submitted to OMB.

Obtaining OMB clearance allowed for pretesting the survey, including tests of methods, materials, survey operations and other related aspects of fielding such a large, complex survey. The pretest phase is described in the section "Pretest Experience and Results" in this e-circular.

TIMELINE FOR THE 2016 NATIONAL HOUSEHOLD TRAVEL SURVEY

FHWA started internal planning for the NHTS in 2011 and in September of 2011, TRB organized the NHTS Task Force Understanding New Directions for the National Household Travel Survey. The scope of this task force was to organize sessions and workshops at TRB's Annual Meetings and other TRB meetings to discuss proposed survey modifications and explore potential impacts on various transportation data user communities. The main focus of the task

force is to reach out to the transportation community regarding the use of NHTS data and potential impacts of the redesign of the survey, and to serve as a bridge between the FHWA and the NHTS data user community. In September 2013, the FHWA began the assembly of its team for the 2016 NHTS with support staff in place to provide user support and data analysis for the FHWA leadership. Recruitment of add-on partners also continued that fall with phone calls, webinars, and informational workshops.

In March 2014, the NHTS team convened a panel of renowned survey methodologists and travel survey experts to review the proposed redesign of the 2016 NHTS. After a day-long session, the panel provided its advice. They affirmed the choice of ABS over RDD to reduce the bias of the sample that would occur if an RDD sample were used, due to the accelerated growth of cell phone-only households that would not be in the RDD frame. They also provided insight into tackling issues like multimode questionnaires, hard-to-reach populations, incentives, and proxy responses.

In July 2014, the RFP for the survey data collection was released, and it was awarded the following September to the survey contractor. The planning and design of the survey commenced with developing the questionnaire, amending it with modern-day topics, and reformatting questions to meet the demands of the newly adopted web interface. The field materials were also updated and reviewed. In spring 2014, the NHTS program convened a team of survey experts to discuss potential changes to the methodological approaches of the upcoming 2016 survey. The composition of the expert panel is shown in [Figure 1](#). In April 2015, the NHTS team reconvened the expert panel in survey methods at the U.S. DOT to provide guidance on the proposed methodology, sample design, questionnaire, and QC measures. The expert panel reviewed the proposed survey design and provided detailed feedback to the NHTS redesign plan. Adjustments were made to the survey accordingly.⁴

PANELISTS:

Mick P. Couper, PhD, Research Professor, Institute of Social Research, University of Michigan;

Don A. Dillman, PhD, Regents Professor, Department of Sociology, Washington State University;

Laura P. Erhard, Senior Economist, Bureau of Labor Statistics;

Paul J. Lavrakas, PhD, Research Psychologist and Senior Methodologist, and Fellow, NORC at U-Chicago, Office of Survey Research at Michigan State University, and Senior Research Advisor at the Social Research Centre (Melbourne);

Steven Polzin, PhD, Director of Mobility Policy Research at the Center of Urban Transportation Research, University of South Florida;

Guy Rousseau, Models & Surveys Manager, Atlanta Regional Commission, MPO, Atlanta, Georgia;

Clyde Tucker, PhD, Principal Survey Methodologist, American Institutes for Research (AIR)

FIGURE 1 Expert panel members.

In October 2015, the OMB issued clearance to conduct the 2016 NHTS. This clearance gave the survey contractor the green light to move forward in the testing and quality assurance (QA)/QC steps of the survey's development. In November of 2015, the pretest was launched to test the methods of the recruitment and retrieval steps in the 2016 NHTS. This coincided with the cognitive testing of the instrument as well as the continued QA/QC by the NHTS team. The pretest along with the internal testing provided substantive feedback to the continued improvement of the survey. The pretest also reiterated the importance of cognitive testing prior to development of the online questionnaire. Documents and the website were translated into Spanish before the survey launch. On March 31, 2016, the first batch of recruitment surveys was mailed to households across the country, initiating the year-long 2016 NHTS data collection effort.

Table 2 shows the timeline for all activities for the 2016 NHTS, from initial planning to final data release.

TABLE 2 Timeline for the 2016 NHTS

Activity	Date
FHWA starts internal planning process	January 11
Preliminary planning, investigate using ABS sample	July 11
ABJ45T Task Force formed	September 11
Add-on recruitment initiated	February 13
Pooled Fund Account established with Matching Waivers Approvals	February 13
Task force conducts various workshop sessions with NHTS stakeholders	May–August 2013
Task Force E-Circular Phase 1 report published	October 13
Work on the RFP started	November 13
Expert panel no. 1	March 14
RFP issued	July 14
Proposals received	August 14
Survey contract awarded to Westat	September 14
NHTS add-on coordination team established	September 14
Preliminary survey plan	November 14
Mode of data collection report	January 15
Sample design	January–March 2015
Field materials	January–April 2015
Expert panel no. 2	April 15
Revise survey materials	May 15
OMB package–DOT review	May–July 2015
Finalize pretest questionnaire	July 15
Task force input on survey content	October 15
OMB package–OMB review	May–November 2015
Develop Internet retrieval survey software	November 2015–February 2016
Pretest	November 2015–January 2016
Revisions based on pretest	February 16
Gear up for full survey	February–March 2016
Full survey	April 2016–April 2017
Task force—second e-circular	January 17
Edit, QA/QC, document the dataset	To be determined
Weight the data—full sample, each add-on sample	To be determined
Produce user's guide	To be determined
Produce summary of travel trends	To be determined
Release of 2016 NHTS—full dataset, each add-on	To be determined

Sample Design

This chapter provides a high level summary of the sample design and focuses on the sample design, coverage, stratification, and sample size in the National Household Travel Survey (NHTS). This section of this e-circular is taken from the Sample Design Report prepared by the Federal Highway Administration and Westat. Complete details are available in the report on the NHTS website.⁵

ADDRESS-BASED SAMPLE DESIGN AND COVERAGE

The national and add-on samples were selected using a single, unified design with a single selection (i.e., the add-on samples are embedded in the national sample design). Using a single selection avoided the complexities and reduction in precision that would result from separate, independent selections for the national and add-on samples. In another major design difference from previous NHTS, the national and 13 add-on areas for the 2016 NHTS comprised a sample of addresses that were selected from the address-based sample (ABS) frame maintained by Marketing Systems Group (MSG). MSG's ABS frame originates from the U.S. Postal Service computerized delivery sequence file (CDS), and is updated on a monthly basis.

The sampling frame for the 2016 NHTS was derived from only the CDS file. Thus, the ABS sample used for the 2016 NHTS inherently has substantially higher coverage than the 2009 NHTS landline RDD sample. (In 2009, about one-fourth of households did not have landline telephones and it has been estimated that an additional 5% to 20% of landline households were excluded from landline RDD frames.) With the ABS approach, identifying targeted areas (e.g., states) that correspond to those for which estimates can be developed from the NHTS data is straightforward. Addresses are definitively linked to states, so state-level estimation is facilitated. Geocoding and geographic information system processing were used to link addresses to counties in a highly reliable fashion. There was some ambiguity for addresses that are P.O. boxes or were listed as rural route addresses, since these addresses do not correspond to the physical location of the household. These types of addresses, while representing only a small proportion of a state's population, were handled using a set of well-defined rules. For example, for sampling purposes, when add-on areas were defined based on county or census tract boundaries, P.O. box and rural route addresses were associated with the census tract associated with the centroid of the ZIP or ZIP +4 code, whichever was available. Thus, no important issues rose in the definition of areas with an ABS sample design that relied on mail for data collection.

STRATIFICATION AND SAMPLE SIZE

The primary purposes of stratification were to improve overall sampling precision and to ensure that specified subgroups in the population (e.g., states, highly urbanized areas) were adequately represented by sufficient numbers of respondents in the sample for subgroup comparisons. For the national study, because of the need to produce state-level estimates with adequate precision, state was a key variable used for stratification. However, in order to support estimates for add-on areas in states containing add-ons, separate strata were formed using the add-on area(s) and the

balance of the state. Thus the primary strata consisted of (1) each add-on area; (2) the balance of the state, for states with substate add-ons; and (3) the state, for states without substate add-ons. Additionally, the following four groups were used to substratify within each primary stratum:

- Counties in metropolitan statistical areas (MSAs) of at least 1 million people and containing heavy rail for transit use (14 such MSAs exist in the United States);
- Counties in MSAs of at least 1 million people and not containing heavy rail for transit use;
- Counties in MSAs of less than 1 million people; and
- Counties not in MSAs.

The national sample size (specified in terms of responding households) was initially allocated among the strata according to the proportion of addresses falling in the stratum (determined by the counts of addresses from the ABS frame). A minimum allocation of 250 responding households per state was used; states with initial allocations of fewer than 250 households were increased to 250, and the remainder of the national sample was reallocated proportionally to the strata associated with the remaining states. For the add-on areas, the add-on sample size [as specified by memoranda of understanding (MOU) with the add-on sponsor] was also allocated among the four substrata above with potential additional substratification, with the allocation based on designated targets for each final substratum as specified in the add-on MOU.

Once the sample of responding households was allocated in the manner described above, these sample sizes were inflated to account for expected losses due to ineligible addresses, based on experience with other national ABS mail studies conducted by Westat, nonresponse to the recruitment effort, and nonresponse to the retrieval effort. The departures from proportional allocation of responding households in the national sample and the supplementation of the sample for add-ons resulted in a sample of addresses selected with variable sampling rates. These variations in sampling rates will be properly accounted for in the computation of the survey weights.

Midway through the data-collection period, the sample was refreshed with the latest available ABS frame from MSG, to reflect any closings or additions of streets and residential buildings. Adjustments to sample releases—mail outs were made on a weekly basis to account for response rates in each geographic stratum and add-on area.

Table 3 shows the national sample size by stratum.

TABLE 3 Expected Sample Sizes for the National Sample by Primary Stratum

National Sample Stratum	ABS 12/14 Occupied Housing Units	Proportion	Stratum Sample Size
Counties within MSAs > 1 million and heavy rail	31,070,705	24.4%	5,996
Counties within MSAs > 1 million and no heavy rail	38,036,786	29.9%	7,157
Counties within MSAs < 1 million	39,573,540	31.1%	8,509
Not in MSAs	18,435,015	14.5%	4,338
Total	127,116,046		26,000

NOTE: The stratum sample size column indicates the expected number of completed household surveys.

WEIGHTING AND ESTIMATION PROCEDURES

After data collection and cleaning is completed, sample weights for the 2016 NHTS will be developed and assigned to the records representing various analytic units associated with the study, such as responding households and persons within responding households, vehicles, and trips. The weights will be designed to permit inference to the corresponding target populations. The weights will be developed so that the expanded survey can be analyzed for the nation, for each add-on area and each state separately. Sample weights will be designed to permit data users to calculate estimates of the person, household, trip, and vehicle variables of interest from the collected data (to the extent state sample sizes will support). Replicate weights will allow users to compute standard errors for the estimates from the collected data.

The process of weighting has three major components. The first is the provision of a base weight, which is the inverse of the overall selection probability of each selected unit. Base weights are needed to account for the varying probabilities of selection among sample units in any given sample. Probabilities vary purposefully to some extent. Since no subsampling within households will take place, household- and person-level base weights will be identical. That is, the base weight for each person in a household is identical to their corresponding household base weight.

The second component of the weighting process consists of adjustments for nonresponse. Nonresponse can occur at the household level at the recruitment stage when a household declines to participate or at the retrieval stage when a household initially participates in the recruitment survey but does not actually participate in the retrieval survey. In either case, selected households who should have participated (according to the sampling scheme) ultimately did not participate. Results for the nonparticipating households are not reflected by the use of base weights, and therefore nonresponse adjustments to these weights are made in an effort to represent the full household population by adjusting the weights of the actual participating sample to account for the nonparticipating households.

The third major component of the weighting is the application of additional adjustments, such as weight trimming and calibration. Unlike the previous two components, trimming is not directed primarily at minimizing the bias of survey estimates, but rather at reducing their variance, permitting more precise statements to be made about the travel patterns and behavior and comparisons among subgroups and over time. Trimming consists of reducing the weights for each participating sample unit whose weight, as a result of the calculation of base weights and the application of nonresponse adjustments, makes an unduly large relative contribution to the total weighted data set. Calibration consists of adjusting the weights of sample units in population subgroups so that the sum is equal to an independent, relatively reliable benchmark estimate of the size of that population subgroup. Calibration will be done at both the household and person levels by using raking procedures. Characteristics such as age, sex, race, ethnicity, census division, MSA size, household size, number of household vehicles, and number of workers will be considered for calibration. The weight trimming procedure will be implemented iteratively with the raking process so that the trimmed portions of the weights will be redistributed across all the remaining weights. This will ensure that the final weights will achieve consistency with the external population distributions without any excessively large survey weights.

Deriving these components of survey weights and combining them to produce a final weight is standard practice in complex sample surveys with some nonresponse.

In addition to the full-sample weights used to generate estimates from the survey, a set of replicate weights will also be created to allow users to compute variances of survey estimates

and to conduct inferential statistical analyses. The replicate weights can be used with a software package, such as WesVar, SUDAAN, STATA, or SAS to produce consistent variance estimators for totals, means, ratios, linear and logistic regression coefficients, etc.

Data users are advised to use weighted data rather than unweighted data when analyzing the NHTS data. Weights help correct for the bias in estimates that would occur due to disproportionate demographic, geographic or temporal sampling of the population and absence of data from nonresponding households that normally occurs in any survey.

Data Collection Methods

As in previous series of the National Household Travel Survey (NHTS), the 2016 NHTS maintained a two-phase study, which includes a household recruitment survey (Phase 1) and trip level retrieval survey (Phase 2). Unlike the previous series of NHTSs, which used a random digit dialing method and only computer-assisted telephone interviewing data collection, the 2016 NHTS uses a mail-out recruitment method with mail-back as the primary recruitment response mode, and phone or web response options for both recruitment and travel day data retrieval. Another important difference is that the 2016 survey defines a completed household as having retrieval data from all eligible household members ages 5 and older. As described above, the data collection uses an address-based sample frame to randomly invite households to participate in the 2016 NHTS. These addresses will be contacted by mail and asked to complete a brief household-level survey instrument and return that survey to the contractor. Members of recruited households will be asked to keep track of all the places they go for 1 day and to report that information to the contractor either online or by telephone. A description of the materials used to conduct the 2016 NHTS follows.

RECRUITMENT MATERIALS

Invitation Letter and Survey Packet

The methodology includes an invitation letter that was mailed to each sampled address in the format of city resident and address. The letter introduces the NHTS, discusses the importance of participation, includes the first incentive (\$2), and describes the incentive structure. The letter requests that the enclosed recruitment survey be completed and returned in the business reply envelope. To increase the perceived legitimacy of the study, the letter included the U.S. Department of Transportation (DOT) logo and was signed by an U.S. DOT official. Including a \$2 cash “primer” incentive in the invitation letter was expected to encourage households to begin participation. [Figure 2](#) shows the recruitment survey.

A toll-free number on the survey materials was provided and the participant had the option to complete the recruitment survey by web. All data collected in the recruitment survey was used to populate the household record in the retrieval survey database. If respondents mailed, called, or used the web to complete the recruitment survey, their responses were collected in the same survey database as the retrieval.

The initial recruitment tool was designed to capture the interest of sampled households by targeting issues likely to resonate with them and engage them in further participation. It was designed as a scannable document and was processed using standard software for intelligent data capture and image processing. All processing was conducted in a secure data facility. This software was used in the design of the recruitment survey, to scan and extract responses, conduct validation tests, and store data. Best practices for security and protecting print materials that contain identifying or confidential information were administered.

National Household Travel Survey

Understanding How People Get from Place to Place



The U.S. Department of Transportation collects information about your travel to understand how well the roads, highways, and bus and rail systems are working and to plan for the future. We are asking you to please help us by taking part in this survey. Your answers help us build a snapshot of how, when, and why people travel in their daily lives.

The information you provide will be used to understand the transportation needs of your community and the nation. Participating is voluntary and your responses will be kept confidential. This survey takes about 8 minutes to complete. If you have comments or suggestions about your participation or this survey, please contact Michael Howell, Information Collection Clearance Officer, Federal Highway Administration, 202-366-8707, Michael.Howell@dot.gov, 1200 New Jersey Avenue, SE, Washington, DC 20590. Please refer to OMB Control Number 2125-0548, expiration date October 31, 2018.

► This form should be completed by an adult household member.
 ► Please use a black or blue pen to complete this form.
 ► Mark to indicate your answer. If you want to change your answer, darken the box with the incorrect answer, and mark the correct answer with an .

Your Travel Experiences

1. How often do you use each of the following to get from place to place?

	Daily	A few times a week	A few times a month	A few times a year	Never
Walk	<input type="checkbox"/>				
Bike	<input type="checkbox"/>				
Personal Vehicle (Car/Truck/SUV)	<input type="checkbox"/>				
Taxi service or rideshare such as Uber/Lyft	<input type="checkbox"/>				
Bus	<input type="checkbox"/>				
Train/Subway	<input type="checkbox"/>				
Paratransit	<input type="checkbox"/>				

2. How much do you agree or disagree with each of the following?

	Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
The price of gas affects the number of places I go.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Getting from place to place costs too much.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I walk to places to save money.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I like to places to save money.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I use public transportation to save money.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Technology You Use

3. How often do you use the following devices to access the Internet?

	Daily	A few times a week	A few times a month	A few times a year	Never
Desktop or laptop computer	<input type="checkbox"/>				
Smartphone	<input type="checkbox"/>				
Tablet	<input type="checkbox"/>				
Other device, please specify	<input type="checkbox"/>				

Your Household and You

4. How many vehicles are owned, leased, or available for regular use by the people who currently live in your household? Be sure to include motorcycles, mopeds, and RVs.
 Please fill in "0" if your household has no motor vehicles.
 Total number of motor vehicles available to your household:

5. Do you own or rent your home?
 Own
 Rent
 Other, please specify

6. Are you of Hispanic or Latino origin?
 Yes, Hispanic or Latino
 No, not Hispanic or Latino

7. What is your race? Mark all that apply.
 White
 Black or African American
 Asian
 American Indian or Alaska Native
 Native Hawaiian or other Pacific Islander
 Other, please specify

8. What is the highest grade or year of school you completed?
 Less than a high school graduate
 High school graduate or GED
 Some college or Associates degree
 Bachelor's degree
 Graduate degree or professional degree

Contact Information

9. Please print your first and last name below.
 First Name: Last Name:

10. Please provide your email address.

11. What is the best telephone number for us to reach you for the next part of the study?

12. Is the number above a cell phone?
 Yes
 No

13. Do you have a landline telephone?
 Yes
 No

14. The second part of this survey can be done online or on the phone. Which do you prefer?
 Online
 Phone

Please continue to the back page. →

15. In order to understand how people get from place to place, it's important for us to know who currently lives in your household. **Including yourself**, please write in the first name, nickname, age, and gender of each person currently living in your household, including children and newborn babies.

Person	First name, nickname, or initials	Does this person drive?		This person's age		This person's gender	
		Yes	No	Age	Gender	Male	Female
Person 1	You	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person 2	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person 3	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person 4	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person 5	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person 6	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person 7	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person 8	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person 9	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person 10	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

16. If there are more than 10 people in your household, please write in the total number of people in your household.

Thank you!
 Please return this questionnaire in the enclosed, pre-paid envelope. For more information about the survey, please visit www.NationalHouseholdTravelSurvey.com or call 1-855-350-NHTS (6487).

Households were selected from the postal service's list of residential addresses. By selecting households randomly, we will be able to create scientific estimates about the households in America. Your number will not be used for any purpose outside of this study. Although we will not be using automatic dialing, we are still required by the Telephone Consumer Protection Act to obtain your consent if the system may be capable of autodialing. By providing your number you agree that we may call your household to complete the survey.

FIGURE 2 Recruitment Survey

Reminder Postcard 1

Reminder postcards, addressed to city resident and designed with the project logo to capture interest, were to each sampled address 7 days after the invitation letter.

Second Invitation Letter and Survey Packet

A second survey packet was mailed to nonresponding addresses 21 days after the first mailing. While this letter was slightly different, the recruitment survey was the same as in the initial mailings. This packet did not include another incentive.

Reminder Postcard 2

Forty-four days after the first mailing, each nonresponding address was mailed a second postcard that included an invitation for participation by web. This packet did not include another incentive, but reminded the household that a small gift will be provided for the completion of the survey. This invitation provided an opportunity for households that were more likely to participate online to do so. The web recruitment survey content was identical to the paper recruitment survey.

Project Website

A project website was created and maintained for the 2016 NHTS. This public website is dynamic and able to provide information about the study and contains frequently asked questions. The website also served as the portal through which survey respondents accessed the online survey, or contacted the data collection contractor.

RETRIEVAL OF TRAVEL LOG MATERIALS

Travel Log Packet

The travel log packet included a letter, an exemplar log on one side and personalized travel logs for each household member ages 5 and older, and was sent using first class postage in an envelope. The envelopes were branded to match the letterhead used for the invitation letter. The second respondent incentive was included with the travel logs. This \$5 cash incentive, appended to the letter, was expected to serve as a good faith incentive to encourage completion of the retrieval survey.

Travel Log Letter

A household letter was included in the travel log packet. The letter thanked participants for agreeing to participate in the survey, further familiarized the participants with the travel recording stage, identified the households' travel date and provided instructions about when and how to complete the retrieval survey. The letter also included a reminder note about the final \$20 household incentive. Similar to the invitation letter, the travel log letter included the U.S. DOT logo.

Travel Logs

A personalized travel log for each household member (age 5 and older) was sent. Depending upon how each household member was identified (that is, name or initials) in the recruitment survey, a label with that identification was affixed to each of the household member’s travel log. The logs were intended to be a memory jogger to guide accurate data collection and aid in the reporting of each place visited on the travel day. **Figure 3** shows the sample travel log.

Exemplar Log

An exemplar log with the instructions for recording the details about the places visited on the travel day was provided to the household. The exemplar log has colorful icons and directional arrows to show the general public how their travel should be reported.

Final Incentive Payment

Once a household has completed the survey a \$20 check was mailed to the household.

Reminder Contacts

Electronic and telephone reminders were used to engage participants, remind them about their travel date and to report their travel. The first reminder was sent when the travel log packet is mailed. Reminders were generally sent in late afternoon on the day before the assigned travel day. Although there was no e-mail receipt required for these e-mails, the data collection contractor’s database system generated summary reports of the reminders sent each day, and the e-mail addresses that failed. The data collection contractors’ telephone research center staff was fully trained on the reminder scripts to be used when phoning participants.

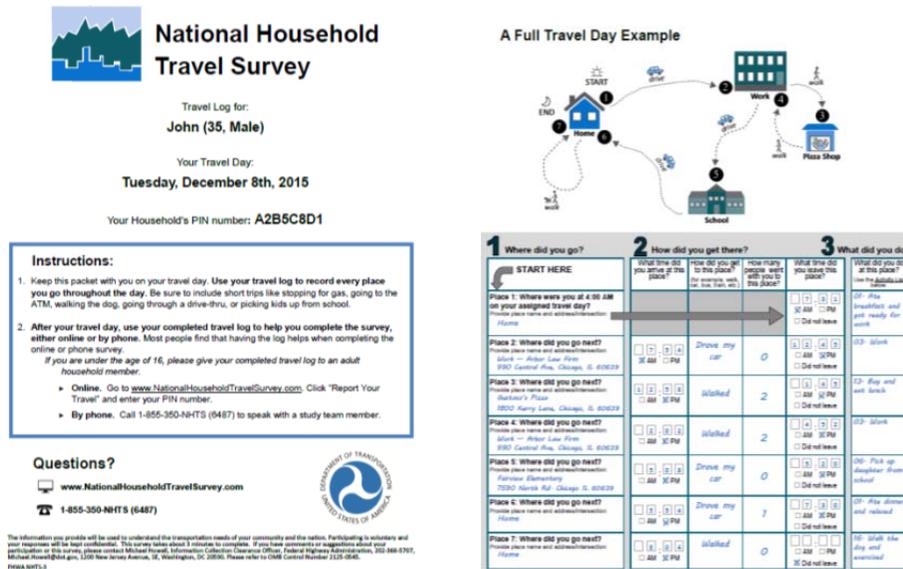


FIGURE 3 Travel Log

Questionnaire Design

With the adoption of new methods in the 2016 redesign, the NHTS applied changes to both the recruitment and retrieval questionnaires with the intent of using an optimal data collection approach that would both modernize the data collection method as well as retain key questions from previous National Household Travel Surveys (NHTSs) to best maintain the ability to produce trend lines. To better capture the growth of cell phone-only households, the 2016 NHTS recruited households via address-based sampling. In lieu of random digit dialing, a paper recruitment survey that contained “engaging questions” were included in the paper survey. A \$2 incentive was included in this first mailing to potential households. Then, 2016 households received a blank travel diary accompanied by an additional \$5 incentive and a promise of a \$20 check upon completion. In contrast, in the 2009 survey the travel diary was accompanied by \$5 and no completion incentive. After the assigned travel day, 2016 households completed the retrieval survey by their choice of phone or web, while travel information in 2009 was collected entirely over the phone.

RECRUITMENT

The first step in acquiring an NHTS respondent is the recruitment process. In April 2015, the expert panel agreed that with today’s decline of landlines and waning interest in taking any kind of survey over the phone, the best way to reach households and achieve a geographically representative sample is via mail. In 2016, the expert panel recommended utilizing a very official-looking recruitment letter that emphasized the importance of federal and state governments working together to improve transportation in local communities. In 2016 an incentive was also included to evoke a feeling of social exchange that is more readily established with the more personal connection established by people conversing over the telephone. In 2009, at least seven attempts via phone were used to reach a household while up to four mailings were utilized in 2016 with only the last postcard offering a web option. The expert panel recommended initially offering only one response mode option in the recruitment because research showed that this improved response rates. The concern that some potential respondents would not participate in a mail-back survey led to the use of both the paper and web versions of the recruitment survey which followed the same question sequencing with the most engaging questions at the beginning. The recommendation was to draw respondents into the survey by first asking questions that piqued their interest in transportation. Engaging questions ranged from trip frequency by means of transportation to fiscal motivation in travel behavior to technology usage. These questions were then followed with some basic household level questions, contact information and the collection of the household roster. Due to the sensitive nature of household income, that question was reserved for the retrieval survey and not used in the recruitment. To best mimic the offerings of the telephone interviewer, following recommendations from the expert panel all instructions and questions were very clearly written and “please” and “thank you” were frequently used. During the questionnaire testing, many suggestions were made to improve the visual appeal and clarity of the written and online recruitment instrument. Various changes to text included the use of bolding, italicizing, improved spacing, table layout, punctuation, rewording, etc.

RETRIEVAL

The day after the assigned travel day had passed for a household, they were either called or e-mailed or texted a reminder to complete their retrieval survey. The retrieval survey collected the bulk of the information needed for the NHTS: complete household roster, individual travel logs for all trips made in the assigned 24-h period, and vehicle inventory, as well as person-level information. Respondents in 2016 had the choice of going to the web or, like in 2009, speaking to an interviewer over the telephone. Again, the expert panel emphasized the need for clarity in all written communication. The questionnaire testing process again resulted in changes to the questionnaire text and headings including bolding, italicizing, improved spacing, table layout, punctuation, and rewording.

To reduce respondent burden there were several help line efforts included in the design. In an effort to address respondent questions throughout the survey, a contact link was present at the bottom of each screen. If clicked, the NHTS hotline number was made visible in a pop-up text box. If the respondent idled on a screen for too long, the same pop up appeared encouraging the respondent to ask questions if needed. The phone number offered assistance for completing the survey; a respondent could return to the web after a short question or remain on the line and finish out the survey as if they had elected the phone retrieval option.

In order to access the online retrieval instrument, a household member had to use a unique household personal identification number to enter their profile with information preloaded from the previously submitted recruitment survey or another household member's previously completed retrieval survey. Proxy respondents were permitted for household members who were not available or too young to self-report. To identify whether the respondent was proxying for another and identify who the response was for, the online retrieval instrument asked verification questions of the respondent as the respondent moved through survey. As each person's travel log was completed, the survey asked who was answering and for whom. Logical checks were applied throughout the survey to help individuals more easily navigate the online instrument, minimizing respondent confusion and burden. For example, only workers were asked questions regarding commute and employment, only motorcycle drivers were asked about the frequency of motorcycle trips, only those using public transit were asked about access and egress means of transportation, etc.

One of the most cumbersome parts of the NHTS for data processing is often the entry of trip details from the travel log. As with previous iterations, the 2016 NHTS utilized paper travel diaries since research has shown this technique resulted in better trip reporting accuracy. Trip rostering procedures for the 2016 NHTS were adapted to suit both web and computer-assisted telephone interview (CATI) data collection from the earlier NHTS surveys conducted by CATI, to reduce burden of household members who traveled together. During trip rostering, each household member was asked to list all trips taken prior to asking about the detail on each individual trip. If the household member currently being interviewed reported that another household member went on a trip with him/her, then this trip was automatically also recorded on the roster for the other household member, provided that household member had not yet been interviewed. When the interviewer talked with this other household member, (s)he merely had to confirm that the household member went on the trip. That household member had to agree with the trip destination and start and end times for the trips to be considered identical.

Many options were also in place (address autofill, mapping, intersection or word search, and more) for the entry of addresses so that more precise geocodes were achieved. These tools

are similar in nature to Google Maps and the Google search engine. Due to the difficulty in understanding the definition of an NHTS trip, the web instrument offered infographics along with written instructions. Capturing loop trips was especially challenging and so a special set of infographics and trip rostering steps were in place to serve as reminders and explanations for recording loops.

Although the use of web as a response mode offers many respondents a means to participate at their convenience and in privacy, the use of CATI in previous NHTS provided an important advantage: real-time interaction between an interviewer and the respondent. Interviewers could clarify survey questions and probe for more complete answers. CATI also allowed for comments to be made by an interviewer so that further review could occur. To offer survey services similar to that of CATI, the web instrument included a number of graphical user interface elements (buttons, drop down lists, balloon help, etc.) to provide clarification of terms throughout the survey. Pop ups also appeared regularly when the screen idled, if typos were entered, or if an answer had been left incomplete. These served as reminders to the respondent as they worked their way through the self-administered survey.

In addition to all the various technical improvements applied to the retrieval instrument, the 2016 NHTS also captured new data about relevant transportation topics like rideshare, bikeshare, teleworking, electric vehicle ownership, etc. Coupling this new data with the core NHTS outputs can allow researchers and policy makers to capture a more complete snapshot of the transportation behavior of U.S. households.

A copy of the retrieval survey is available at http://nhts.ornl.gov/2016/pub/NHTS_Retrieval_Instrument_20160411.pdf.

Pretest Experience and Results

The pretest of the 2016 National Household Travel Survey (NHTS) was designed to accomplish several goals, including the following:

- To test the feasibility of using a mail-recruit approach followed by the retrieval portion conducted primarily on a web-based approach, supplemented with telephone retrieval responses when requested;
- To estimate response rates at the recruit and retrieval stages and how actual field work compared with the estimates in the proposal; and
- To test the systems and processes designed to conduct the survey.

The first issue was the timing of the pretest. Conducting a pretest of approximately 500 households required Office of Management and Budget (OMB) clearance, which was originally anticipated over the summer of 2015. OMB clearance was not received until early November which created a timing issue for the pretest, namely whether the holiday period would allow for response rates that could be used for effective estimates of a 13-month period data collection effort. Despite this concern, the pretest was conducted during the November 2015 to January 2016 period to minimize any further delays in getting the full survey fielded.

The pretest was designed to complete interviews with 500 households consisting of 100 in the Atlanta, Georgia, metropolitan area; 100 in Tulsa, Oklahoma; and another 300 randomly spread nationwide. The Atlanta area was chosen because of the high percentage of African-American population and the high percentage of families below the poverty line. Tulsa allowed for interviewing Native Americans and a less-urban population. The remainder of the pretest households was randomly spread across the United States. To achieve the goals in these three subsamples, a gross sample of 2,886 addresses was selected, consisting of 578 addresses in Atlanta and Tulsa and 1,730 nationwide. Each address was assigned a day of the week to ensure coverage and balance across all potential travel days.

Because of time constraints to conduct and complete the pretest, the recruitment packages for all 2,886 households were mailed on November 13, 2015. In the full 13-month NHTS, recruitment packages are staggered across the year.

Pretest time constraints also impacted testing all elements of the full survey follow-up procedure. In the full NHTS, a postcard is sent 44 days after the initial recruit package is mailed to offer the respondent the option of completing the recruit survey online. This aspect of the survey was not included in the pretest, so it has been monitored closely in full survey operations.

PRETEST RESULTS

The pretest produced a number of results that were significant in preparing for the full NHTS. The mailing and scanning operations and all other administrative survey functions planned for the full survey proved to be effective. The pretest provided important information on the cycle of response to the recruit survey (that is, how responses to each mail-out accumulate over time). Such information was essential to knowing what to expect in the full survey and planning the assignment of travel days to cover a full year of travel.

The pretest also showed that the impact of increasing or decreasing the volume of surveys mailed played out over a much longer period than for sample release adjustments in a computer-assisted telephone interview surveys. This is another contrast with earlier surveys in the NHTS series where the volume of recruit contact could be increased or decreased overnight simply by changing the flow of phone numbers to the interviewers.

One of the primary goals of the pretest was to determine the feasibility of meeting the originally projected response rates of 30% for the recruit and 65% for the retrieval, which would yield an overall response rate of 19.5%. The pretest was a shortened version of the full survey in that it abbreviated the time allowed for a contacted household to reply and did not allow for the postcard that is mailed 44 days after the first mailing, which encouraged completing the recruit survey online. This postcard element was carefully monitored during the first few months of the full survey to determine its impact on response rates. Conducting the pretest over the holiday season was controversial, but deemed better than delaying the full survey. It was not clear whether the distractions of the holiday season may have had an impact on survey response. The pretest concluded with a 24.9% recruitment rate and a 54.2% retrieval rate, for an overall response rate of 13.5%. Proposed estimates of the effect of postcard raise the overall response rate to 16.3%, which is still short of the original projections. Response rates will be measured and tracked carefully during the full survey.

In household travel surveys it is important to know and record whether a person is self-reporting their travel day travel or whether a proxy household member is reporting it. In previous iterations, the NHTS has captured whether the travel day data is reported by self or proxy. Determining this and encouraging self-reporting was relatively easy to do in a phone interview mode. With the switch to online data collection, proxy reporting increased. This led to adjustments in the web instrument to better encourage self-reporting.

There were several positive results from the pretest. The systems designed to manage the survey from the initial mailing through checking the retrieval data all performed well. A few minor adjustments were made to improve survey flow and the experience of respondents, but there were no major problems uncovered in this area. The pretest volume was too small to fully check the systems at maximum survey capacity, but showing that they performed well was a positive outcome. The import of this was that the change from a previously run telephone survey to a combination of mail-back and web based did not reveal any serious survey administration problems.

In earlier NHTS surveys there has been high nonresponse to the household income question. The pretest showed a much better response to this item, which may be due to the anonymity of responding online. Likewise, the response frequency for estimate of annual miles driven improved considerably in the pretest.

All of the major pretest issues will be monitored closely throughout the full survey. Response rate and sample representativeness are the two biggest outstanding indicators of survey quality moving forward.

Concluding Remarks

The 2016 National Household Travel Survey (NHTS) represents a unique break in the trend line established by the NHTS series and its predecessor survey, the Nationwide Personal Transportation Survey (NPTS). Data users must take great care not to attribute changes in travel to elements that may be the result of significant changes in the survey itself. This section will present how the 2016 survey differs from previous surveys in the series.

TREND ANALYSIS

The 2016 NHTS reflects major survey changes primarily because the nation and technology have changed considerably over time. The earliest surveys in the series, those conducted in 1969, 1977, and 1983, were administered as face-to-face surveys using Census Bureau staff. To improve coverage and keep costs within reason, the surveys done in 1990, 1995, 2001, and 2009 were all conducted by phone, using a random-digit dialing sample frame and computer-assisted telephone interviewing (CATI). The change to a phone-based survey in 1990 was major, but it took place when the American public was still willing to participate in surveys over the phone. Thus it could be assumed that the samples were still composed of a representative group of U.S. households. In 1995, the NPTS changed from a retrospective data collection (that is, “where did you go yesterday?”) to a prospective two-stage survey with the use of a travel diary and an assigned travel day. This change was major and some analysis was done to adjust the 1990 data to a two-stage survey design. Thus, some comparisons between 1990 and 1995 could be made on a more-even footing (using data labeled as 1990 Adjusted). Going forward the two-stage survey was continued, so changes in travel could be assumed to be the result of changes in travel behavior, not in survey methods. This worked through the 2009 NHTS data.

The issue with the 2016 NHTS is not only the way it is being collected (addressed-based sample with mail-back, web, and telephone collection) but also that the way we communicate has changed so drastically over the past decade that we cannot adequately account for those factors in our new data. In the past, when a survey series adopted new technology or a new approach, the standard procedure was to conduct a portion of the sample using the previous approach to serve as a bridge over time. Like households and groups could be measured with the old approach and new approach and some kind of a quantitative measure of change due to methods could be developed. This was never intended to be an exact measure, but it gave analysts some sense of the amount of change attributable to methods. These measures served the user community as a warning light to recognize the degree of change that may be the result of survey method, not change in behavior.

The expert panel of leading American survey methodologists that advised the Federal Highway Administration (FHWA) on the NHTS suggested not even trying a parallel subsample using 2009 methods. The universe of households using landlines over that time has decreased and changed so substantially that it would not be comparing apples to apples.

While FHWA agreed not to conduct a 2009 method subsample in the 2016 NHTS, it was noted that the user community needed some guidance on trend data. A question was added to the 2016 survey to ask whether the household had a landline. Data from this subset of households

will be analyzed to at least provide some guidance to the user community on what may be the result of survey changes versus what may be the result of changes in travel behavior.

More guidance of the issue of NHTS trends analysis will be offered in the future and at the time the survey data become available.

FUTURE RESEARCH

As the time for release of the next NHTS nears (early 2018) attention can turn toward the research agenda for use of the new data. There are several opportunities and challenges relating to the exploration of the new data.

As with prior NHTS surveys, there will inevitably be a host of public and private applications spread over many years. Broad use in a variety of applications is encouraged but there may be an opportunity to coordinate sharing of research results and carry out strategic planning to ensure that critical research efforts are prioritized, executed in a timely manner, peer reviewed, and widely disseminated.

Given the time since the last survey and the dynamics in travel behavior as a result of changes in demographics, economic conditions, and technology impacts on travel behavior, and given the changes in survey methods, basic research carried out in a timely manner to produce core travel behavior metrics would be very helpful. These initial efforts can serve as benchmarks for subsequent researchers to evaluate their analyses against. In addition, they can provide guidance on how to address trend analysis where researchers will have to attempt to differentiate the survey effect from actual travel changes and provide insight and guidance as to how this might be done.

There are a number of widely used core research and analysis efforts. The Summary of Travel Trends is one of these but there are several others such as the various analyses of transit use, information on vehicle–energy use, data on trip chaining–tours, analysis of long-distance travel, and others. There may be value in understanding what is planned or programmed in these areas. This might include reviews of prior highly referenced NHTS studies and seeing if efforts for their updating are planned.

The emergence of technology as a critical factor influencing travel through actions such as communication substitution for travel, use of shared mobility services (transportation network companies, bikeshare, short-term car rental) and ultimately automated or connected vehicles are very critical policy issues. A variety of research efforts to evaluate the NHTS data with regard to current changes and household–travel behavior characteristics that are critical to understand the role of automated technologies in the future will be a high-interest area of research.

There may be an opportunity to have a collective conversation of how NHTS data can be fused with other data sources to enhance its research applications. Sharing of best practices and or sharing enhanced data sets may merit attention and encouragement. There may be value in advocating for specific data set enhancements as part of an overall NHTS research program.

Historically there have been some informal efforts to keep track of research hypotheses for study with NHTS data. These were informally shared with university researchers and graduate students. There may be value in having something of a more formal forum for sharing research ideas as well as findings. This could build on efforts that have gathered bibliographies of prior research and use the lessons learned from the 2016 survey to inform the next NHTS or continuous surveys.

Notes

1. Dillman, D., J. Smyth, and L. Christian. *Internet, Mail, and Mixed-Mode Surveys: The Tailored Design Method*. John Wiley & Sons, Hoboken, N.J., 2009.
2. If an assigned travel date must be changed, the day of week will remain consistent and the date offered will be the next calendar date for that day.
3. Vincenty, T. Direct and Inverse Solutions of Geodesics on the Ellipsoid with Application of Nested Equations. *Survey Review*, Vol. 23, No. 176, 1975, pp. 88–93. Available at http://www.ngs.noaa.gov/PUBS_LIB/inverse.pdf. Accessed August 6, 2014.
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